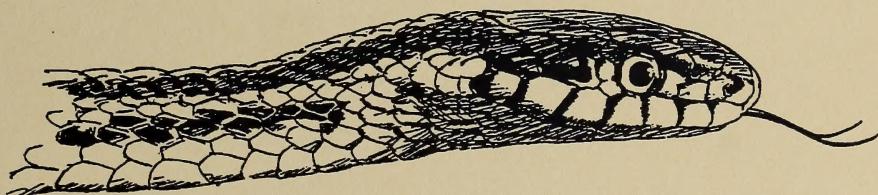


Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) Literature Review

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ABSTRACT

The following literature review on the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) was prepared for Alberta Environmental Protection – Fisheries and Wildlife Management Division. The objective of the literature review was to acquire information on garter snake ecology, and summarize information on effective historic and present translocation techniques and practices. Due to the similarities in natural history, ecology and behavior of many snake species, literature research was not limited to *Thamnophis sirtalis parietalis*. Other species of snakes included: *Thamnophis spp.*, the Smooth Snake (*Coronella austriaca*), the Prairie Rattlesnake (*Crotalus viridis*), and the Blue Racer (*Coluber constrictor foxii*). Topics investigated included garter snake ecology, translocation studies, and capture and marking techniques. From the evidence of an extensive literature search, little work has been devoted to garter snake translocation attempts. Research on other snake species that are more charismatic, or whose populations are less abundant and are considered at risk, are more complete. Studies involving translocation attempts and dispersal patterns of the Prairie Rattlesnake (*Crotalus viridis*) and the Blue Racer (*Coluber constrictor foxii*) are two examples. As a result, this literature search was expanded to encompass other snake species for which data pertinent to the topics currently under investigation were available, in an attempt to incorporate any applicable information. This report is comprised of two components: 1) literature obtained from journal articles, books, and other publications, and 2) personal communications from herpetologists across Canada and the United States. Hard copies of the literature reviewed in this document are currently held at Alberta Environmental Protection, O.S. Longman Building, Edmonton, Alberta. Alternately, hard copies of the material referenced can be located using the NEOS library service.

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Finally, I would like to thank Bill Koonz (NRS, Manitoba) and Robert Willson (University of Guelph) for providing contact information and Dr. Milton Ness (Veterinarian, Edmonton) for his clinical advice regarding scale clipping and PIT (Passive Integrated Transponder) tagging snakes.

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DISCLAIMER

The personal communications outlined herein are summaries of verbal discussions with knowledgeable individuals. These comments have not been reviewed and should not be referenced unless speaking to the individual. Contact information is outlined on page 22 of this document.

Alberta's timber rattlesnake population is estimated to be around 1,000 individuals in the province's range. Today, the snake and its habitat is in a conservative stage of its decline, as it is in most snake populations. In Alberta, all three prairie subspecies are currently listed as "Threatened". Under this designation, a different level of protection is given to long-term declining populations (Alberta Wildlife Management Branch 2004).

Snakes and other reptiles are poached from trophy ranges, often for their skins and/or surrounding habitat, and are unable to regulate their own body temperatures. As a result, snakes that occur in northern Alberta experience frequently unpredictable and turbulent weather. Snakes typically hibernate in rock crevices, where they hibernate congregating in large numbers, representing a large proportion of the population in some areas. These occurrences of snakes other than hibernating den in areas with deer, moose, grizzly, Cougars, coyotes, ravens, snakes and other, become a safe, hibernating den for snakes, where temperatures remain above freezing due to the insulating effects of the ground. When snakes are often forced to move from a rocky surface and naturally return to the same location. Snakes also congregate in areas of standing, bare trees of dead, as the tree are more stable and relatively provide shelter, in winter/wintering sites.

This dependency on overwintering den sites have made populations vulnerable to disturbance, degradation and encroachment. The Beldings' Lizard (Dipsosaurus dorsalis) is classified as a non-jeopardized species, and under the Alberta Wildlife Act is not afforded protection from harassment and attempt to injure or kill. Under the Alberta Wildlife Act, herpetofauna are protected from disturbance and destruction from 1 September to 30 April (Alberta Environmental Protection 1996a).

In April 1996, Fish and Wildlife received a complaint call from landowners about a snake hibernaculum located on the West River on their property. For further protection, the

DISCUSSION

As mentioned before, the main aim of this paper was to compare the results of the two methods for the estimation of the mean dimension and the absolute dimension of the $2^{\mathbb{N}}$ space. The following table summarizes the results of the two methods for the two methods. The following table summarizes the results of the two methods for the two methods.

INTRODUCTION

The Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) is one of three garter snake species that occur in Alberta. The other two species are the Plains Garter Snake (*Thamnophis radix*) and the Wandering Garter Snake (*Thamnophis elegans*).

Garter snakes were once considered a common and widespread species across much of their range. Today, the public and biologists alike perceive a long-term decline in garter snake numbers. In Alberta, all three garter snake species are currently listed as “Yellow A”. Under this designation wildlife species merit extra attention due to long-term, declining populations (Alberta Wildlife Management Division 1996a).

Snakes and other reptiles are poikilothermic (body temperature changes with their surroundings), and are unable to regulate their own body temperature. As a result reptiles that occur in climates that experience freezing temperatures must hibernate in order to survive. Snakes typically hibernate in dens called hibernacula, where they frequently congregate in large numbers representing a large proportion of the population in a given area. These populations of snakes often share favourable den locations with other snake species. Communal den sites provide snakes with a safe, humid place to spend the winter, where temperatures remain above freezing due to the insulating effects of the ground. Hibernacula are often found in areas with a rocky subsurface and naturally occurring pits, fissures or crevices. Snakes also choose rocky outcrops or sinkholes, burrows of small to medium size mammals and occasionally people’s cellars, as over-wintering sites.

This dependency on over-wintering den sites leave snake populations vulnerable to disturbance, degradation and extirpation. The Red-sided Garter Snake is classified as a non-licence species, and under the Alberta Wildlife Act it is not afforded protection from harassment and attempt to injure or kill. Under the Alberta Wildlife Act, hibernacula are protected from disturbance and destruction from 1 September to 30 April (Alberta Environmental Protection 1996b).

In April 1998, Fish and Wildlife received a complaint call from landowners about a snake hibernaculum located on the front lawn of their property. For various reasons, the

landowners felt it was in their best interest to remove the snakes from the property. Alberta Environmental Protection and Alberta Conservation Association biologists made a decision to relocate the unwanted snakes to an existing, active hibernaculum, close to the original site. Upon completing an extensive search of the Alberta Snake Hibernaculum Inventory records, a relocation site was chosen in an abandoned gravel pit approximately six miles to the east of the original site. The relocation site was chosen on the basis of similar vegetation, geology and topography as well as relatively close proximity and assurance of long-term protection by the landowner. In addition, this site is already in use as a den by conspecifics. This Red-sided Garter Snake translocation project was initiated in the fall 1998 and is ongoing.

This literature review document provides a compilation of current and historic literature relating to the subject of garter snake and snake ecology, and snake translocation studies. The information contained in the references compiled in this document will be used to help increase our understanding and knowledge of garter snake ecology as it relates to the Red-sided Garter Snake translocation project. In addition, information on translocation projects and techniques within these references will aid in the success of future translocation studies by: 1) identifying possible sources of error in study designs, 2) providing effective and efficient methods of capturing and marking snakes, and 3) providing key information on hibernation and hibernaculum ecology, and garter snake natural history as it relates to translocation projects.

METHODS

Information and research contained within this literature review was acquired through an extensive search of the NEOS library consortium (which included the use of the Gate catalogue and CD-ROM databases of various government, college and university libraries) at the University of Alberta. Materials not held at the University of Alberta were obtained using the interlibrary loan service. Literature and information was also obtained through personal communications with herpetologists and biologists throughout North America (see disclaimer, page iv).

Topics researched included: relocation and translocation studies, hibernaculum and hibernation ecology, individual and population ecology, movements and habitat use, reproduction and diet, capture and marking techniques and practices, ecological physiology, life history parameters, spring emergence ecology, orientation abilities and mechanisms (chemical ecology), freeze tolerance and thermal regulation. Due to extensive overlap in subject matter between references, the references are ordered alphabetically by author and date in the literature review. In addition, pertinent literature is summarized by broad topics and listed alphabetically by author and date.

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Personal Communications

Didiuk, Andrew – Canadian Wildlife Service, Saskatoon, Saskatchewan, 314 Egbert Avenue, Saskatoon, Saskatchewan S7N 1X1

Andrew sent information regarding trap design and techniques.

Donald, Brett – Freeway Enterprises Ltd., Box 45, Site 430, R.R. 4, Stony Plain, Alberta T7Z 1X4

Both Brett Donald (current landowner) and Michael Northcott (past landowner) contribute valuable personal knowledge regarding the period of activity at the hibernaculum, relative numbers of snakes, and general movements and occurrences of garter snakes in the area.

Both individuals observed and believed that the snakes from the hibernaculum in the gravel pit on Brett's land disperse in the direction of Kilini creek, which lies west of the den site. Abundant forest, with some wet areas, occurs in the area between the creek and the den.

Mike observes more snakes on Brett's property than on his own. His land occurs at a higher elevation, and consists of upland forest with little or no wet areas. In addition, Mike has indicated that in some years large numbers of snakes are killed as they bask on and cross the road south of the den site (indicating a direction of dispersal).

Brett estimates that the number of snakes that occupy the hibernaculum at the gravel pit is in the thousands. He reports seeing thousands of snakes in the spring congregating "knee deep" in a shallow depression at the base of the hill in which the hibernaculum occupies.

Brett Donald reports seeing snakes as late as October 21, 1998 at the gravel pit hibernaculum location.

Gregory, Patrick, T. – Department of Biology, University of Victoria, P.O. Box 3020, STN CSC, Victoria, British Columbia V8W 3N5

Patrick had no further information to contribute regarding garter snakes and the topics researched. The information obtained through researching the extensive papers and

studies authored and undertaken by Patrick accurately reflects his views and thoughts on the subjects investigated.

Ilnicki, Brian - Ducks Unlimited Canada, 930-6 Avenue Wainwright, Alberta T9W 1E2

Brian Ilnicki, along with Wayne Roberts (University of Alberta Museum) co-ordinated the Ducks Unlimited garter snake relocation and hibernaculum reconstruction project. Knowledge of the details regarding this project are based on personal communications with Brian Ilnicki.

The original hibernaculum was located under a porch that consisted of a concrete pad attached to a house. The subsurface under this concrete pad consisted of a variety of backfill materials such as gravel, rock and larger aggregates of concrete. The primary problem with the location of this hibernaculum was that snakes were gaining entry into the landowner's residence.

When the concrete pad (porch) was removed it was discovered that the snakes in the hibernaculum were seeking out and exploiting the warmth radiating from the foundation of the house.

A new hibernaculum was created approximately 200 m north of the original den site on the property. With the aid of heavy equipment a large hole was dug and back filled with gravel, rocks, pieces of concrete pipe, sticks and railway ties. In addition, back fill material was obtained from the original den site. The newly constructed den was then covered with sod and fenced (due to horses in the area).

On the September long weekend, snakes were hand captured from the original hibernaculum and placed in the new one. One-foot high screen drift fencing and 24 inch deep holes (with diameters of about 12-16 inches) were dug in efforts to capture snakes. Fencing was also used to contain snakes at the new den. The fencing, however, was found to be ineffective on the lawn, because snakes were able to crawl over and under it. Throughout the fall the property owners relocated snakes to the new den site. None of the snakes were marked in any way prior to relocating.

In the spring, following the relocation, snakes were observed at the newly constructed hibernaculum indicating that they successfully survived the winter. The next fall also yielded snakes at the new hibernaculum. Since then Brian has not personally surveyed the new den site, although Wayne Roberts has. According to Brian, this is the third fall since the project was undertaken, and since then little follow up has occurred. This project was never considered to be a long-term study by Ducks Unlimited; rather, it was commenced because DU was doing a lot of other work in the area, they knew the landowners, and the cost of the project was minimal.

Larche, Ronald, A. – Manitoba Department of Natural Resources, Wildlife Branch, Box 24, 200 Saulteaux Crescent, Winnipeg, Manitoba R3J 3W3

Ron has primarily conducted work on garter snakes that occur near the Narcisse Dens in Manitoba, Canada where large numbers (thousands) of snakes congregated each year to spend the winter. Ron has been involved with the problem of large number of snakes being killed due to vehicular traffic as they disperse and congregate at the den sites at Narcisse. Attempts to reduce road mortality involved erecting barriers, to divert snakes from crossing the road, to a culvert that runs under the road. These initiatives have had limited success, but discussions with the Manitoba Department of Highways and Transportation and further experimentation are ongoing.

Larsen, Karl – Department of Biology, University of Victoria, P.O. Box 3020, STN CSC, Victoria, British Columbia V8W 3N5

Karl Larsen has worked on garter snakes in the past and is currently studying the feasibility of relocating a rattlesnake population in British Columbia.

Karl Larsen suggests scale clipping no lower than the third scale from the vent. This is to help prevent any possible injuries to vital organs of the snakes, during the process of scale clipping. In addition, Karl recommended the use of eye surgery scissors due to their precision and high quality.

Based on the work he has been involved with, Karl found that 99% of garter snakes examined at a hibernaculum had empty stomachs. According to Karl the garter snakes must have empty stomachs during hibernation in order to avoid food rotting in their stomachs over winter. He says that dehydration is the main cause of mortality in over wintering snakes, rather than starvation.

Mason, Robert, T. – Department of Zoology, Oregon State University, Corvallis, Oregon, 97331-2914.

Bob believed that there was not much value in pit tagging since scale clipping accomplishes the same result (i.e. individual identification). He also recommended not to scale clip on the tail because of the small size of scales and possible loss of tail during interactions with predators. He prefers a Sclero Punch for making notches in the scutes of snakes.

Bob indicated that scales are not alive and will not grow back over the winter. When the scales do grow back there should be a white or light colored “scar” or tattoo where the scale was clipped.

Bob agreed with the method of both temporary holding practices used in our study (i.e. lab sinks and outdoor enclosures). He also feels it is a good idea to mix the snakes from the two sites prior to releasing the relocation snakes into the new den. However, he

figures that they will follow one another chemically regardless whether they were mixed or not.

Orchard, Stan, A. – Research Associate, Royal British Columbia Museum, 1745 Bank Street, Victoria British Columbia V8R 4V7.

Stan has researched and studied the homing abilities in translocated painted turtles in the southern Okanagan Valley of southcentral British Columbia.

Regarding our garter snake study he feels that the adult (relocated) garter snakes (if any) will most likely return to the original den site. This is due to the many years of imprinting on that sight (coupled with their strong and well-established natural homing instincts). He also feels of the relocated snakes, the adults will be the least likely to accept and adapt to the new (gravel pit) hibernaculum.

In terms of scale clipping snakes at the gravel pit hibernaculum, Stan feels it would be worthwhile for determining the extent, if any, of common use between the two hibernacula. He also pointed out that there may be a chance that snakes from the gravel pit den site may follow relocated snakes (if any) that successfully find their way back to their original den at the lawn site.

Porchuk, Ben - University of Guelph/private consultant, 82 Hunt Avenue, Richmond Hill, Ontario L4C 4G9.

Ben is involved with Blue Racer translocations, hibernaculum construction, and artificial nesting sites. Through correspondence, Ben has brought to attention several papers on the topics researched.

Powell, Larry – Department of Biological Sciences, University of Calgary, Calgary, Alberta, 2500 University Drive T2N 1N4

In regards to scale clipping, Larry recommended (based on his previous experiences with bull snakes and rattlesnakes) clipping the scales on the tail. This was to reduce possible fatal injuries to vital organs. However, Kendell and Takats (pers. comm.) found (in the case of garter snakes) that clipping the tail scutes limited the ease of reading the individual scale clip I.D. pattern due to their small size (especially on young snakes) of the scales. Also, the possible combination of scale clip patterns was limited because some scales were too small to clip, or were fused to the skin. In addition, some snakes had broken or damaged tails that made it impossible to mark them.

Larry provided information on a company (Avid Canada Ltd.) that sold PIT tags and he gave advice on which model of scissors worked best for scale clipping. Larry also indicated the best location for the pit tag as well as the technique for implantation. He recommended that pit tags be placed dorsally a few centimetres to one side of the spine anterior to the vent. Physiologically, this was the safest location for an implant due to a lack of vital organs in the area.

Finally, Larry recommended obtaining as much scientific and research data as possible while the snake is in hand (i.e. scale clip and/or pit tag, weigh, age, measure SVL and total length, note unique individual characteristics, and identify sex when possible).

Russell, Anthony, P. – Department of Biological Sciences, University of Calgary, 2500 University Drive, Calgary, Alberta T2N 1N4

Tony's direct experience with snakes involved the rattlesnake tagging study in Alberta. He proposed that the success of the translocation project would be measured by whether or not the relocated snakes return to the new den the following fall. He recommended marking the relocated snake a second time after emergence and a proportion (or all, if feasible) of the existing original population.

Takats, Lisa – Non game biologist, Alberta Conservation Association, 7th floor O. S. Longman Building, Edmonton, Alberta T6H 4P2.

Lisa is the co-ordinator of the Alberta Amphibian Monitoring Program, Alberta Snake Hibernaculum Project, and RANA (Researching Amphibian Numbers in Alberta). Recent work involving snakes includes the red-sided garter snake translocation study, initiated in the fall 1998, near Stony Plain, Alberta. This will be a two year study, completed in the spring, 2001.

SUMMARY OF CONTACTS

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Porchuk, Ben	University of Guelph	(905) 884-2940	bporchuk@yahoo.com
Powell, Larry	University of Calgary	(403) 220-2687/289-9311	lpowell@acs.ucalgary.ca
Russell, Anthony, P.	University of Calgary	(403) 220-5251	
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Willson, Robert	University of Guelph		rwillson@uoguelph.ca

SYNTHESIS

In Alberta, there has been limited scientific long-term study regarding the translocation of snakes from one hibernaculum to another, existing or artificial. Extensive research has been undertaken in Alberta involving the Prairie Rattlesnake (*Crotalus viridis*) and garter snakes (*Thamnophis spp.*), primarily studying movement patterns and ecology. In Manitoba, considerable research has been conducted on the study of garter snakes, particularly regarding patterns of emergence, dispersal and orientation, life-history parameters, and ecology. In British Columbia, research conducted on garter snakes includes thermal ecology, natural history, and ecology. Canadian studies involving hibernacula include that of the Blue Racer (*Coluber constrictor foxii*) found on Pelee Island, Ontario, the Prairie Rattlesnake (*Crotalus viridis*) in Alberta, and garter snakes (*Thamnophis spp.*) in British Columbia, Alberta and Manitoba. The majority of research involving garter snakes in Canada is focussed on thermal and chemical ecology, orientation mechanisms and dispersal patterns, natural history, and ecology; including hibernation, reproduction, habitat use, and diet. There is extensive literature on tagging and marking snakes.

Although the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) and other garter snakes in Alberta are wide ranging, the majority of the populations are localized. Therefore, there is a need to protect existing populations and their centers of dispersal (i.e. hibernacula), in order to prevent these local populations from being extirpated. A successful translocation of garter snakes will provide management options for both “problem snakes” and land use issues, in Alberta and other provinces. In addition it will provide valuable information instrumental in reintroducing snakes to abandoned den sites or relocating snakes into artificial hibernacula.

Procedures and methods used in the Red-sided Garter Snake translocation study, near Stony Plain Alberta, have been discussed with various wildlife scientists throughout North America. These discussions have generated helpful advice and opinions regarding the translocation study.

Regarding this translocation study, all snakes have been captured by hand as they basked or were observed near the hibernaculum. All snakes captured were marked and had specific data collected on them. PIT (Passive Integrated Transponder) tags and scale clipping were

the two means used to mark individual snakes. The PIT tags, for the study were obtained from AVID Canada Ltd. (Powell, pers. comm.). PIT tags were implanted in the same location on each individual snake to ease identifying them. They were implanted dorsally approximately 3 cm posterior the vent to avoid areas of vital organs (Powell, pers. comm.). Scale clipping allowed for long-term, individual identification, by leaving notches and later light scars on the scutes of the snakes (Mason, pers. comm., Powell, pers. comm.). Surgical scissors where used to scale clip the scutes on the individual snakes because of their accuracy and precision (Larsen pers. comm., Powell, pers. comm.). An alternate, effective scale clipping tool, called a Sclero Punch, can be used (Mason pers. comm.); however scales were difficult to clip using this tool (Takats and Kendell, pers. comm.). All scale clip patterns were initiated no lower then the third scale from the vent and anterior to the vent (Larsen, pers. comm., Mason, pers. comm.). This was for two reasons: 1) to avoid any possible injuries to the vent area during the scale clipping process (Larsen pers. comm.) and, 2) to avoid any difficulties in reading scale clip patterns or problems regarding lost or damaged tails from interactions with predators (Mason, per. comm.). Scale clipping on tail scutes was avoided due to: 1) difficulty in reading individual identification patterns because of the small scale size, 2) difficulty in clipping the frequently fused scales (with no leading edge), and 3) difficulty maintaining a standardized scale clip pattern on lost or reduced tails. Prior to release, captured snakes where temporarily held in deep lab sinks (for processing and recording data), and later in outdoor enclosures (Mason, pers. comm.). The processed snakes were weighed, measured (SVL and total length), aged (YOY, subadult, adult) and examined for unique identifying characteristics (i.e. broken tails, scars, etc.) (Powell, pers. comm.). Due to difficulty in distinguishing male and female snakes based on tail length and probing, snakes were not sexed (Takats and Kendell, per. comm.).

Progress on, and the results of the translocation study will be published by Alberta Environmental Protection/Natural Resources Service and Alberta Conservation Association, in the future. Final evaluation of the study is scheduled for fall 2001.

LITERATURE REVIEW-SYNTHESIS

The following is a synthesis of the literature reviewed as it relates to various topics involving the ecology, management and conservation of the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) and other snake species.

ECOLOGY

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